8. REGULATIONS AND ADVISORIES

The international, national, and state regulations and guidelines regarding hydrogen sulfide in air, water, and other media are summarized in Table 8–1.

An acute-duration inhalation MRL of 0.07 ppm was derived for hydrogen sulfide. This MRL is based on a minimal LOAEL of 2 ppm for a >30% alteration in two measures of lung function that are suggestive of bronchial obstruction (airway resistance and specific airway conductance) in 2 out of 10 persons with asthma (Jappinen et al. 1990). Although two measures of lung function were altered in two of the subjects, there were no statistically significant alterations in lung function for the whole group. The MRL was derived by dividing the unadjusted LOAEL by an uncertainty factor of 27 (3 for the use of a minimal LOAEL, 3 for human variability, and 3 for database deficiencies). Further details on the derivation of this MRL can be found in the MRL worksheets in Appendix A of this profile.

An intermediate-duration inhalation MRL of 0.02 ppm was derived for hydrogen sulfide. This MRL is based on a NOAEL of 10 ppm and a LOAEL of 30 ppm for olfactory neuron loss and basal cell hyperplasia in the nasal olfactory epithelium of rats exposed for 6 hours/day, 7 days/week for 10 weeks (Brenneman et al. 2000). The NOAEL was adjusted for intermittent exposure and multiplied by the regional gas dose ratio (RDGR) for extrathoracic effects to calculate a human equivalent concentration (HEC). The MRL was derived by dividing the $NOAEL_{HEC}$ by an uncertainty factor of 30 (3 to extrapolate from animal to human using dosimetic adjustment and 10 to account for human variability). Further details on the derivation of this MRL can be found in the MRL worksheets in Appendix A of this profile.

EPA has derived a chronic inhalation reference concentration (RfC) for chronic exposure to hydrogen sulfide. The RfC of 0.002 mg/m^3 (0.001 ppm) is based on a NOAEL of 13.9 mg/m^3 (10 ppm) and a LOAEL of 41.7 mg/m^3 (30 ppm) for nasal lesions of the olfactory mucosa in rats (Brenneman et al. 2000). The $NOAEL_{HEC}$ of 0.64 mg/m^3 was divided by an uncertainty factor of 300 (3 for interspecies extrapolation with dosimetric adjustment from rat to human, 10 for sensitive populations, and 10 for subchronic exposure) (IRIS 2006).

Table 8-1. Regulations and Guidelines Applicable to Hydrogen Sulfide

Agency	Description	Information	Reference
INTERNATIONAL			
Guidelines:			
IARC	Carcinogenicity classification	No data	IARC 2006
WHO	Air quality guideline (averaging time of 24 hours)	0.15 mg/m^3	WHO 2000
	Drinking water guideline	Not of health concern at levels found in drinking	WHO 2004
NATIONAL			
Regulations and Guidelines:			
a. Air			
ACGIH	TLV (8-hour TWA)	10 ppm[a]	ACGIH 2005
	STEL	15 ppm[a]	
EPA	Accidental release prevention of regulated toxic substances; threshold quantity	10,000 pounds	EPA 2006b 40CFR68.130
	Interim AEGL-1[b]		EPA 2006a
	10 minutes	0.75 ppm	
	30 minutes	0.60 ppm	
	60 minutes	0.51 ppm	
	4 hours	0.36 ppm	
	8 hours	0.33 ppm	
	Interim AEGL-2[c]		
	10 minutes	41 ppm	
	30 minutes	32 ppm	
	60 minutes	27 ppm	
	4 hours	20 ppm	
	8 hours	17 ppm	
	Interim AEGL-3[d]		
	10 minutes	76 ppm	
	30 minutes	59 ppm	
	60 minutes	50 ppm	
	4 hours	37 ppm	
	8 hours	31 ppm	
NIOSH	REL (10-minute ceiling TWA)	10 ppm	NIOSH 2006
	IDLH	100 ppm	
OSHA	Acceptable ceiling concentration	20 ppm	OSHA 2006d 29CFR1910.1000, Table Z-2
	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift		
	Concentration	50 ppm	

Table 8-1. Regulations and Guidelines Applicable to Hydrogen Sulfide

Agency	Description	Information	Reference
NATIONAL *(cont.)*			
	Maximum duration	10 minutes once, only if no other measured exposure occurs	
OSHA	PEL (8-hour TWA) for construction industry	10 ppm	OSHA 2006b 29CFR1926.55, Appendix A
	PEL (8-hour TWA) for shipyard industry	10 ppm	OSHA 2006a 29CFR1915.1000, Table Z
	Highly hazardous chemicals that present a potential for a catastrophic event at or above the threshold quantity	1,500 pounds	OSHA 2006c 29CFR1910.119, Appendix A
b. Water			
EPA	Designated as a hazardous substances pursuant to Section 311(b)(2)(A) of the Clean Water Act	Yes	EPA 2006c 40CFR116.4
	Drinking water standards and health advisories	No data	EPA 2004l
	Reportable quantity of hazardous substance designated pursuant to Section 311 of the Clean Water Act	100 pounds	EPA 2006e 40CFR117.3
	Water quality criteria		EPA 2006d
	Freshwater CCC	2 µg/L	
	Saltwater CCC	2 µg/L	
c. Food			
FDA	Generally recognized as safe	Yes	FDA 2006
d. Other			
ACGIH	Carcinogenicity classification	No data	ACGIH 2005
EPA	Carcinogenicity classification	No data[e]	IRIS 2005
	RfC	$2x10^{-3}$ mg/m^3	
	RfD	Withdrawn	
	Superfund; designated as a hazardous substance pursuant to Section 311(b)(2) of the Clean Water Act and Section 3001 of the RCRA		EPA 2006f 40CFR302.4
	Reportable quantity	100 pounds	
	RCRA waste number	U135	
	Superfund; extremely hazardous substances; threshold planning quantity	500 pounds[f]	EPA 2006g 40CFR355, Appendix A
	Superfund; toxic chemical release reporting; effective date	01/01/94	EPA 2006h 40CFR372.65
NTP	Carcinogenicity classification	No data	NTP 2005

Table 8-1. Regulations and Guidelines Applicable to Hydrogen Sulfide

Agency	Description	Information	Reference
STATE			
a. Air			
Arizona	Ambient air quality guideline		Arizona DEQ 2005
	1 hour	0.045 ppm	
	24 hours	0.027 ppm	
	Annual	No data	
California	Ambient air quality standard		CalEPA 2005
	Averaging time	1 hour	
	Concentration	0.03 ppm	
Delaware	Ambient air quality standard		Delaware DNREC 2005
	Average concentration taken over any consecutive three minutes	0.06 ppm	
	Average concentration taken over any consecutive 60 minutes	0.03 ppm	
Maine	Hazardous air pollutant and reporting threshold	200 pounds	Maine DEP 2005
Minnesota	Ambient air quality standard		Minnesota PCA 2004
	Half-hour average not to be exceeded over two times a year	0.05 ppm by volume	
	Half-hour average not to be exceeded over two times in any five consecutive days	0.03 ppm by volume	
Missouri	Ambient air monitoring yearly standard (30-minute average)	0.05 ppm	Missouri DNR 2005
Montana	Ambient air quality standard (1-hour average); not to be exceeded more than once per year	0.05 ppm	Montana DEQ 2005
Nevada	Ambient air quality standard (1-hour averaging time)	0.08 ppm	Nevada DEP 2005
New York	Ambient air quality standard (1-hour averaging time)	0.01 ppm	New York DEC 2005a
North Carolina	Hazardous and toxic air pollutant	Yes	North Carolina DENR 2005
Oregon	Air toxic	Yes	Oregon DEQ 2005
Wisconsin	Hazardous air contaminant; acceptable ambient concentration for emission rate		Wisconsin DNR 2004
	<25 feet	1.1664 pounds/hour	
	≥25 feet	4.8960 pounds/hour	
	Ambient air standard (24-hour average)	0.083 ppm	
	Hazardous air contaminant	Yes	

Table 8-1. Regulations and Guidelines Applicable to Hydrogen Sulfide

Agency	Description	Information	Reference
STATE *(cont.)*			
b. Water			
Maine	Drinking water guideline	80 µg/L	HSDB 2006
Wisconsin	Drinking water guideline	30 µg/L	HSDB 2006
c. Food			
	No data		
d. Other			
Iowa	Health effects standard	30 ppb	Iowa DNR 2004
New Jersey	Hazardous substance	Yes	New Jersey DEP 2005
New York	Identification and listing of hazardous waste	Yes	New York DEC 2005b
New York	Land disposal restrictions	Yes	New York DEC 2005c

[a]Notice of intended changes: adopted values are those for which changes are proposed.
[b]AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
[c]AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long lasting adverse health effects or an impaired ability to escape.
[d]AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.
[e]Under the Draft Revised Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1999), data are *inadequate* for an assessment of the carcinogenic potential of hydrogen sulfide. No relevant data could be located from which to develop an assessment.
[f]Chemicals on the original list that do not meet toxicity criteria but because of their high production volume and recognized toxicity are considered chemicals of concern (``Other chemicals'').

ACGIH = American Conference of Governmental Industrial Hygienists; AEGL = Acute Exposure Guideline Level; CCC = Criterion Continuous Concentration; CFR = Code of Federal Regulations; DEC = Department of Environmental Conservation; DENR = Department of Environment and Natural Resources; DEP = Department of Environmental Protection; DEQ = Department of Environmental Quality; DNR = Department of Natural Resources; DNREC = Department of Natural Resources and Environmental Control; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; HSDB = Hazardous Substances Data Bank; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life or health; IRIS = Integrated Risk Information System; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PCA = Pollution Control Agency; PEL = permissible exposure limit; RCRA = Resource Conservation and Recovery Act; RfC = reference concentration; RfD = reference dose; STEL = short-term exposure limit; TLV = threshold limit values; TWA = time-weighted average; WHO = World Health Organization